

APPENDIX E

EXPLOSIVE TRANSPORTATION & OPERATIONS PLAN



ARCO ENVIRONMENTAL REMEDIATION LLC

EXPLOSIVE TRANSPORTATION & OPERATIONS PLAN

BLAST EFFECTS ON STRUCTURES, FACILITIES, OR MARINE VESSELS

Figure 17, located in the Explosive Analysis and Methodology section of this document, shows a calculated maximum peak pressure of 80.8 psi at a distance of 100 feet with a 7.2 lb charge. This initial overpressure calculation assumes the charge is placed below the mudline, however, water depth is not considered in this formula. Due to the water depth, approximately 28 feet to 32 feet, this overpressure effect would surface within approximately 30 feet of the detonation origin (Dr. Dave Leidel, JRC). This immediate surface reflection of the blast wave would effectively eliminate the potential for even the calculated overpressure to reach any facility beyond approximately 30 feet from the column being blasted.

The closest facility to the detonation origin during this period would be the barge or vessels used for the project. The execution procedure calls for the barge to be winched to a point approximately 150 feet away from the structure prior to detonation. All other vessels would be moved at least 150' away also. The calculated minimum peak overpressure that could cause damage to a steel hulled vessel within 100 feet of the detonation origin is upwards of 500 psi (Dr. Dave Leidel, JRC). Again, this potential for damage would be negated due to the shallow water depth at the project location.

The only other facilities near the remnant PRC-421 structure are the VENOCO seep line at a distance of 900 feet, Ellwood Pier at a distance of 4,890 feet, the barge Jovan mooring at a distance of 8,550 feet and finally Platform Holly at a distance of 12,450 feet.

Since it is proposed that the detonations be made in rapid succession, blast effects on the other columns is not an issue. As described in Figure 17, the peak pressure is a rapidly decaying dynamic load that will have a negligible effect (less than the prevailing wave action), on the other columns or piles supporting the columns.

SEVERING CONTINGENCIES

The attached Explosives Transportation, Handling and Operations Plan, prepared by Jet Research Corporation (JRC), addresses the safety contingencies applicable to using explosives on the ARCO Pier PRC-421 project.

Fairweather Pacific, ARCO and JRC have evaluated several column removal methods from personnel safety and environmental effects perspectives. Additionally, the economics and functionality of these removal methods were evaluated. From our analysis, it has been determined that the proposed external cutting method, using Linear Shaped Charges, is potentially the most effective and operationally suitable method. Our planned contingencies include having sufficient spare charges in the unlikely event of a misfire, however, we do not anticipate using any other severing methods. Divers, with underwater cutting equipment will be used to complete any partial cuts only after the columns are toppled and safely resting on the seafloor.

JRC



JET RESEARCH CENTER

**DEMOLITION AND SAFETY PROCEDURES
FOR THE DEMOLITION AND REMOVAL OF
ARCO BIRD ISLAND PIER PRC-421 PROJECT**

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I. OVERVIEW OF OPERATION

The explosive operation for this job will be a two-part operation. The first phase will be the safe transportation of explosive to the work site; the second phase will be the explosive cutting of the steel H-Beam piles using Linear Shaped Charges (LSC).

Once the H-Beams have been exposed and Fairweather Pacific has the area ready to blast JET RESEARCH CENTER will mobilize our blasting crew to location with the explosive cutters and start loading and blasting the H-Beam piles as described later in this blast plan. Because each operation has such varying conditions this plan has been designed to be as flexible as possible when considering design, but specific on safety and control.

Vibration and over pressure control will be accomplished by the use of small explosive charge weight per detonation, length of delay between detonations, and the use of detonator accuracy.

1. Peak Particle Velocity on nearest structure (100 feet) should not exceed 1.04 inches per second.
2. The incident peak overpressure on nearest structure (100 feet) should not exceed 80 psi.

Phase One:

Safe transportation of the explosive to the work site.

1. These explosive Shaped Charge Cutters are custom fabricated for your underwater project at Jet Research Center's Alvarado, Texas manufacturing plant. Once they are assembled and pressure tested each cutter is properly packaged for shipment as per USDOT and the United States Coast Guard as required.
2. Prior to departure from the Alvarado plant location these cutters are secured in an approved offshore box/storage magazine. Once the transportation magazine is properly loaded and secured in will be loaded onto and secured in place on a DOT approved truck for transportation to the approved explosive-out pier.
3. This truck will be properly inspected and placarded in accordance with current DOT regulations. Driver will have all current licenses and permits and all required safety equipment to transport explosive.



Phase Two Blast Plan design will be as follows:

1. Since the columns will not be removed from the site, only toppled in place, all H-Beam charges will be detonated in rapid succession. Once on site the JRC blasting representative will advise the specific placement location on each of the column H-Beams thus allowing the charges to facilitate optimum toppling directions.

2. Once all H-piles have been exposed to a depth below the seabed, divers will attach the external Shaped Charges and secure them in place. To obtain the best toppling control two (2) of the shaped charges will be placed approximately one foot lower than the opposite charges in an effect to force the column to fall in the required direction. Each H-beam pile will be severed using Linear Shaped Charge placed on and around the piles and detonated in rapid succession.

- | | |
|---|----------------------------------|
| 2. Type explosive | Copper Clad Linear Shaped Charge |
| 3. Core load | 3200 grain/foot |
| 4. Target | W-12 H-Beam piles |
| 5. Penetration at optimum standoff | 1.70 inches |
| 6. Distance to closest structure | 100 feet |
| 7. Maximum amount of explosive per cut | 7.2 pounds |
| 9. Estimated overpressure to nearest structure (see detail analysis) | 80 psi |
| 10. Peak Particle Velocity on nearest structure should not exceed 1.04 inches per second. | |
| 11. Exploding bridge wire initiator system. | |



Below is a list of explosive products and specifications that we intend to use on this job.

PRODUCT	CLASS	DESCRIPTION	DENSITY	VELOCITY	DIAMETER
Linear Shaped Charges	1.1D	Flexible Linear Shaped Charge (LSC)	1.6	27,000 fps	N/A
Exploding Bridgewire Detonators	1.4B	EBW detonators 3,000 volts/1,000 amps to fire	N/A	N/A	N/A

The detonation system will be the Reynolds Industries Exploding Bridgewire Initiation System. These EBW detonators will be used because of the inherent safety features of the system along with its accuracy, flexibility and ease of use. This system also precludes interference from radio transmissions and static electricity. Although ground vibration will not be a major factor during this operation, the Peak Particle Velocity (PPV) in (inch per second) should always be considered. The PPV can be estimated using the below equation where:

Peak Particle Velocity is:	Radial Velocity component	$V_r = .052 (R/W^{.512})^{-1.63}$
	Vertical Velocity component	$V_v = .071 (R/W^{.421})^{-1.74}$
	Transverse Velocity component	$V_t = .035 (R/W^{.521})^{-1.28}$

The other consideration, and maybe the most importation, that should be keep in mind is the peak overpressure and the incidental specific impulse. Again these can be estimated using the below equations; where:

Peak Overpressure is:	$P_o = 8510 (W^{.333333}/R)^{1.18}$
Incident Specific Impulse is:	$I_m = .931 W^{.333333} (W^{.333333}/R)^{1.11}$

Where:

R= Distance to closest structure

W= Explosive weight per delay

II. DEMOLITION & LOADING PLAN FOR H-BEAM PILES

It is not the intention of JET RESEARCH CENTER to disrupt the normal day to day routine of the area during this undertaking, only to supply a necessary service to Fairweather Pacific in the demolition and removal operation of the thirty-two H-beam piles supporting the 96" columns in a safe manner.

During all phases of this operation all Federal, State and Local laws and safety regulations are to be followed. All required safety equipment will be on hand and used as required. At anytime personnel or equipment are in danger the operation will be secured until the danger is eliminated or removed. Safety of all personnel and equipment is the first and foremost consideration.

PROCEDURE FOR RUNNING EXPLOSIVE CUTTERS

Starting Conditions:

This procedure assumes that the Explosive Technician from Jet Research Center is at the worksite. It should be noted that the Explosive Technician is the authority during the handling of the explosive cutters and devices. Safety is of the up-most importance and absolutely no handling, wiring or employment of explosive cutters or devices will be permitted without the Explosive Technician's direct involvement and supervision.

Set-up:

1. Test fire through the circuit using the correct test fire device for the detonator being used, once the test is finished turn off all power to the firing circuit and ensure the firing system is grounded.
2. String required amount of wire in such a manner that it will layout without fouling. Leave approximately 6 feet of wire on both ends to make connections.
3. Bring one (1) explosive cutter assembly from storage. Mount the explosive cutter assembly to the delivery system (diver's down line, crane line, etc.).
4. With all nonessential personnel moved a safe distance from the operation the explosive technician will make the final wiring connection between the firing wire and cutter. **All power to the Radios will be off during this operation as an additional safety precaution.**
5. The cutter assembly is now ready for deployment.

Procedure:

1. As soon as possible, after the cutter is wired into the detonation system, the explosive cutter should be deployed (with the power turned off to all radios).
2. Place the explosive cutter at the required location on the target (h-beam piles).
3. Once diver is satisfied that the cutter is correctly secured to the targets check surrounding area to assure all cutters and firing leads are correctly placed, return to the surface.